University of Sussex
Physics and Astronomy Examinations Sub-Board

Table of Physical Constants

Revised January 2008

Electron rest mass	m_e	9.109×10^{-31} kg
Proton rest mass	M_p	1.6726×10^{-27} kg
Electronic charge	e	1.6022×10^{-19} C
Speed of light in free space	c	2.9979×10^{8} m s^{-1}
Permeability of free space	μ_0	$4\pi \times 10^{-7}$ H m^{-1}
Permittivity of free space	ϵ_0	8.854×10^{-12} F m^{-1}
Planck's constant	h	6.626×10^{-34} J s
Reduced Planck's constant	$\hbar = h/2\pi$	1.0546×10^{-34} J s
	$\hbar c$	197.33 MeV fm
Boltzmann's constant	k_B	1.3807×10^{-23} J K^{-1}
Gas constant	$\mathcal{R} = k_B/m_H$	8.250×10^{3} J kg^{-1} K^{-1}
Molar gas constant	R	8.315 J mol^{-1} K^{-1}
Avogadro's number	N_A	6.022×10^{23} mol^{-1}
Standard molar volume		22.414×10^{-3} m^3 mol^{-1}
Unified atomic mass unit (^{12}C scale)	u	931.5 MeV/c^2 = 1.660538×10^{-27} kg
Mass of hydrogen atom	m_H	$1.0078u = 1.6735 \times 10^{-27}$ kg
Bohr magneton	μ_B	9.274×10^{-24} A m^2 or J T^{-1}
Nuclear magneton	μ_N	5.051×10^{-27} A m^2 or J T^{-1}
Proton magnetic moment	μ_p	$2.7928\mu_N$
Neutron magnetic moment	μ_n	$-1.9130\mu_N$
Bohr radius	a_0	5.292×10^{-11} m
Fine structure constant	$\alpha = e^2/(4\pi\epsilon_0\hbar c)$	$(137.04)^{-1}$
Compton wavelength of electron	$\lambda_C = h/(m_e c)$	2.4263×10^{-12} m
Rydberg's constant	R_∞	1.0974×10^{7} m^{-1}
	$R_\infty hc$	13.606 eV
Stefan-Boltzmann constant	σ	5.671×10^{-8} W m^{-2} K^{-4}
Radiation density constant	$a = 4\sigma/c$	7.561×10^{-16} J m^{-3} K^{-4}
Gravitational constant	G	6.673×10^{-11} N m^2 kg^{-2}

Rest masses of some leptons and hadrons in MeV/c^2:

$e^{\pm}$ 0.5110, $\mu^{\pm}$ 105.66, $\tau^{\pm}$ 1777, π^0 134.98, $\pi^{\pm}$ 139.57, $K^{\pm}$ 493.7, K^0 497.7, η 547, D^0 1865, $D^{\pm}$ 1869, p 938.3, n 939.6, Λ^0 1115.7, Σ^+ 1189, Σ^0 1193, Σ^- 1197, Ξ^0 1315, Ξ^- 1321, Ω^- 1672, Z^0 91.187×10^3, $W^{\pm}$ 80.41×10^3.

Quark	Charge	I_3	S	C	B	T	Mass (GeV/c^2)
u	$+\frac{2}{3}$	$\frac{1}{2}$	0	0	0	0	∼0.003
d	$-\frac{1}{3}$	$-\frac{1}{2}$	0	0	0	0	∼0.006
c	$+\frac{2}{3}$	0	0	+1	0	0	∼1.25
s	$-\frac{1}{3}$	0	-1	0	0	0	∼0.11
t	$+\frac{2}{3}$	0	0	0	0	+1	174.3
b	$-\frac{1}{3}$	0	0	0	-1	0	4.2

Astrophysical Data

1 astronomical unit	AU	1.496×10^{11} m
1 parsec	pc	3.086×10^{16} m
Luminosity of Sun	$L_\odot$	3.85×10^{26} W
Mass of Sun	$M_\odot$	1.989×10^{30} kg
Radius of Sun	$R_\odot$	6.96×10^{8} m
Mass of Earth	M_E	5.9742×10^{24} kg
Radius of Earth	R_E	6.3781×10^{6} m

Other data and conversion factors

1 ångstrom	Å	10^{-10} m
1 fermi	fm	10^{-15} m
1 barn	b	10^{-28} m^2
1 pascal	Pa	1 Nm^{-2}
1 standard atmosphere		1.0132×10^{5} Pa
Standard acceleration due to gravity	g	9.807 m s^{-2}
1 electron volt	eV	1.6022×10^{-19} J
	eV/hc	8.065×10^{5} m^{-1}
	eV/k_B	1.1604×10^{4} K
Wavelength of 1 eV photon		1.2399×10^{-6} m

Trigonometrical identities

$$\sin(\theta + \phi) = \sin(\theta)\cos(\phi) + \cos(\theta)\sin(\phi)$$
$$\cos(\theta + \phi) = \cos(\theta)\cos(\phi) - \sin(\theta)\sin(\phi)$$
$$\sin\alpha + \sin\beta = 2\sin\tfrac{1}{2}(\alpha+\beta)\cos\tfrac{1}{2}(\alpha-\beta)$$
$$\cos\alpha + \cos\beta = 2\cos\tfrac{1}{2}(\alpha+\beta)\cos\tfrac{1}{2}(\alpha-\beta)$$
$$\cos\alpha - \cos\beta = 2\sin\tfrac{1}{2}(\alpha+\beta)\sin\tfrac{1}{2}(\beta-\alpha)$$

In a triangle ABC, $a/\sin A = b/\sin B = c/\sin C$

and $a^2 = b^2 + c^2 - 2bc\cos A$

Prefixes

T = tera = 10^{12}
G = giga = 10^{9}
M = mega = 10^{6}
k = kilo = 10^{3}

c = centi = 10^{-2}
m = milli = 10^{-3}
μ = micro = 10^{-6}
n = nano = 10^{-9}
p = pico = 10^{-12}
f = femto = 10^{-15}